
Inland Empire Dairy Manure to Energy “Cow Power” Renewable Energy Program

April 2006



Inland Empire
*UTILITIES AGENCY **

Inland Empire Utilities Agency

Leading the Way on Renewable Energy...

■ In the Nation:

- ❑ Constructed **first and largest** Platinum LEED-rated energy efficient headquarters by a public agency in the nation

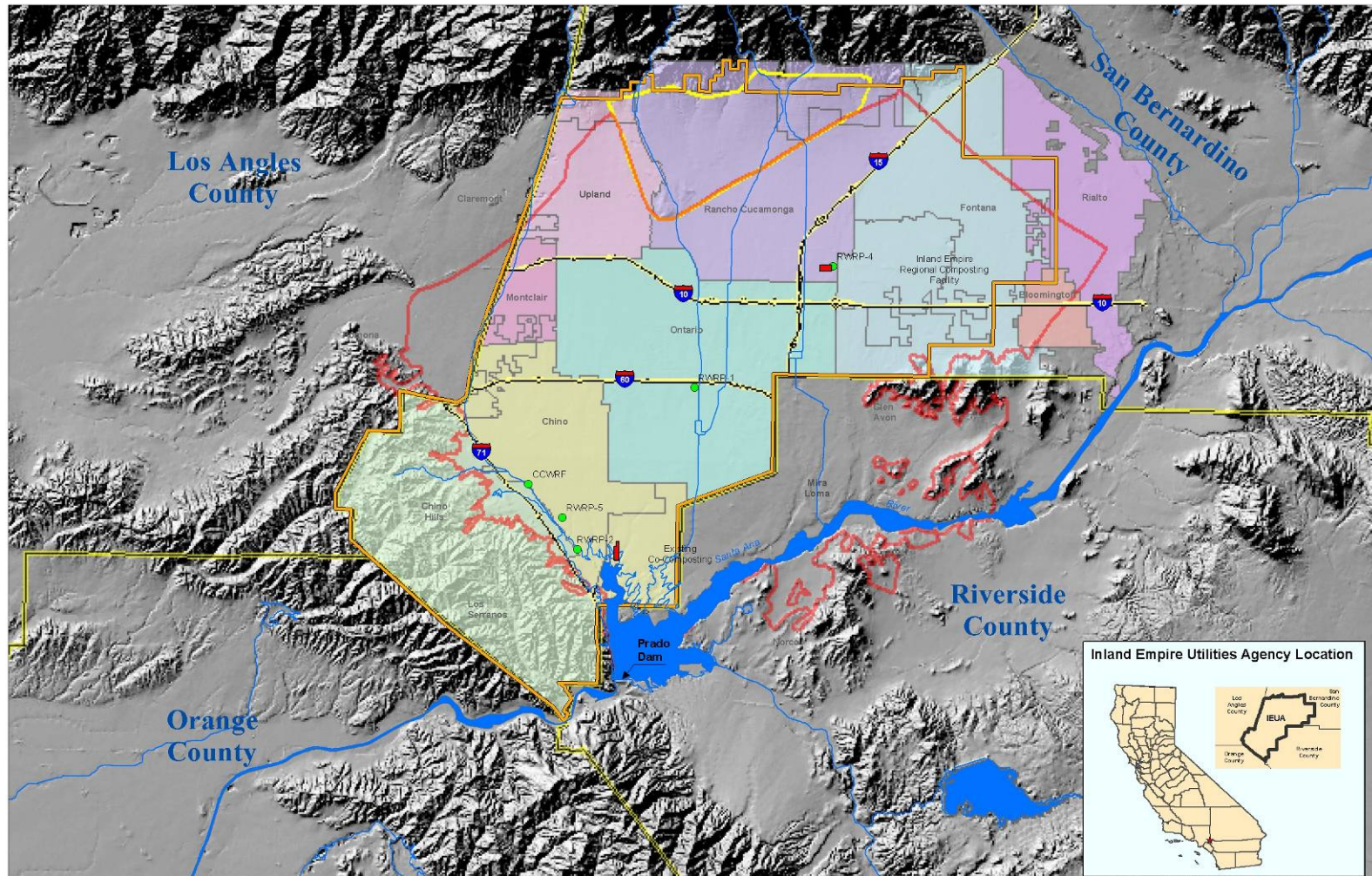
■ In California:

- ❑ Constructed **first** centralized digester in California using a combination of dairy manure and green waste
- ❑ Sold **first** renewable energy credits in California that were generated by “cow power”
- ❑ Sold **first** green-house gas credits in California that were generated by “cow power”
- ❑ Sponsored California’s **first** legislation to authorize “net metering” program for energy generated through “cow power” and was the **first** public agency to use the net metering program

VISION STATEMENT

Inland Empire Utilities Agency's vision is to promote water conservation, water recycling, groundwater management, organic composting, renewable energy, and overall environmental stewardship in partnership with the communities we serve.

IEUA's Service Area is in Southern California



IEUA Profile: Municipal Water Agency

- **Regional wholesale distributed water and wastewater treatment for 7 cities, two water districts, and two water companies**
 - Imported water supply distribution
 - Four regional wastewater treatment plants
 - Two non-reclaimable wastewater sewer pipeline systems
 - One reverse osmosis desalination plant (joint power authority)
 - Biosolids and organics management, the State's first completely-enclosed composting facility (under construction)
 - Recycled water program
 - Water conservation program
 - **Serve 242 square miles of drought challenged Chino Basin**
 - Desert climate zone of So. CA averages 13" rainfall per year
 - **High urban growth (part of Santa Ana River Watershed)**
 - Annual population growth between 1990 and 2000 > 3% per year
 - Population 780,000 projected to grow to 1.0 million by 2025
 - Agricultural land conversion lands to urban use will increase demand for water
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IEUA's Energy Challenges

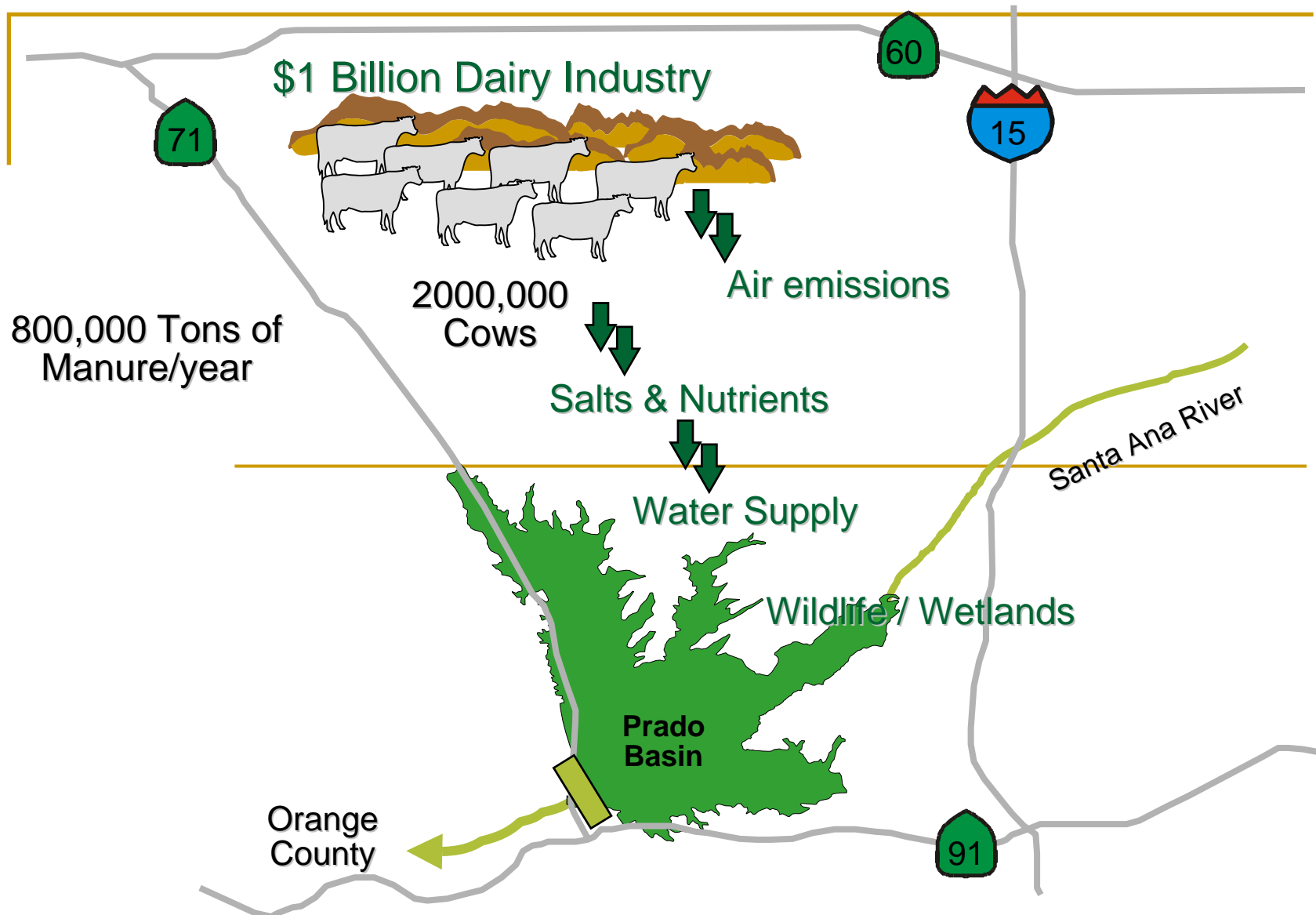
- Current energy load is 10 MW (average) and 13 MW (Peak); annual energy budget is over \$6 million
- IEUA's energy load is expected to grow 180% by 2010 due to increased wastewater treatment, composting and recycled water pumping
- Energy costs will grow significantly over the next five years. Current rate increases in California included 25% for electricity and 50% for natural gas
- IEUA current self generates 43% of its electricity and 64% of the gas used to produce power – estimated annual savings of \$1.2 million

IEUA's Energy Strategies

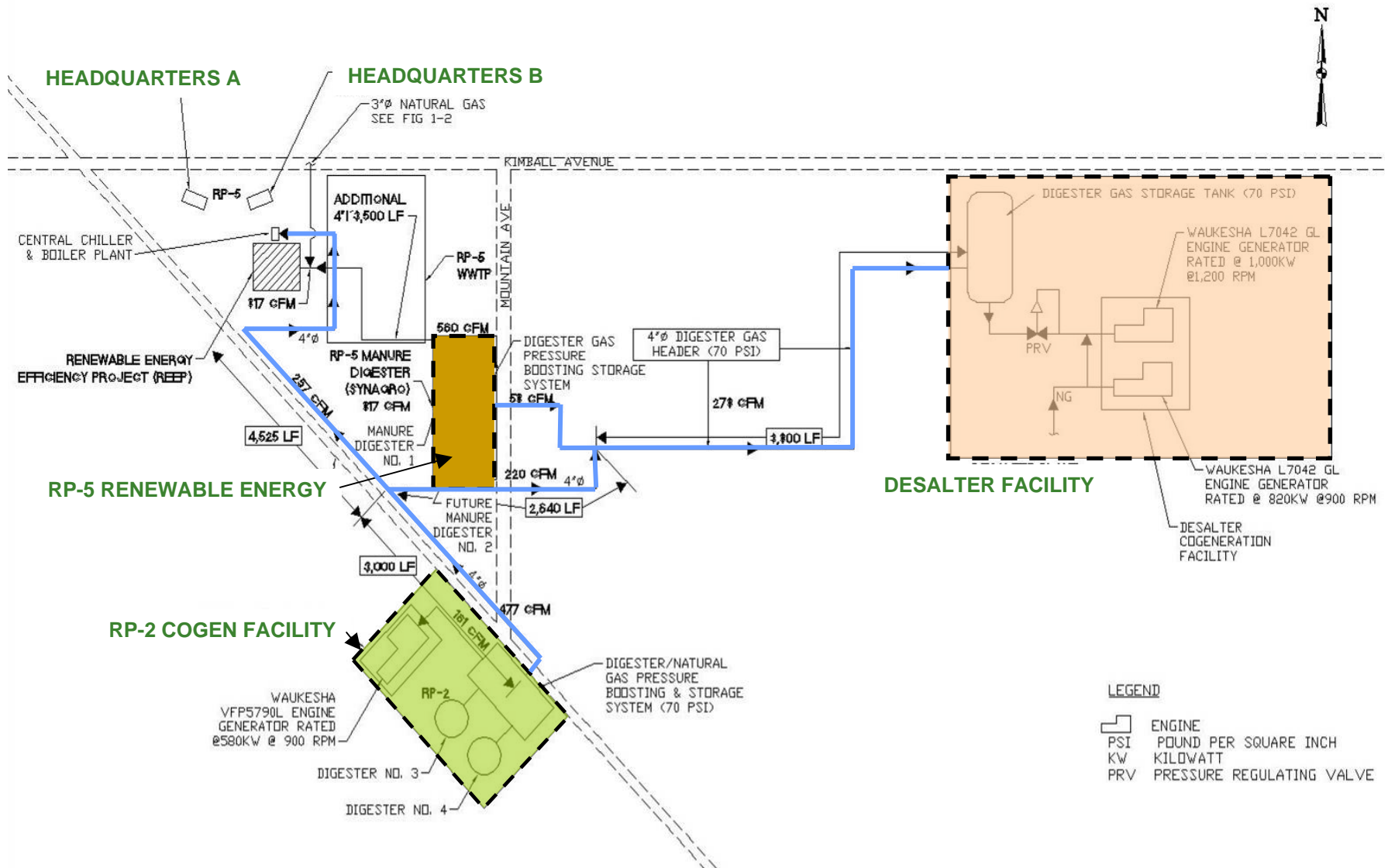
■ **Seven Point Energy Plan implemented since 2001 to minimize IEUA's energy costs. Key elements include:**

- ❑ Incorporate energy efficiency best practices in all operations, including first Platinum LEED headquarters constructed by a public agency in nation
- ❑ Shift all possible peak loads to partial and off-peak periods
- ❑ Maximize digester gas production and renewable energy generation
- ❑ Develop new local energy resources including conversion of dairy manure and other organics to methane gas – 3.5 MW total expected additional generation within next three years
- ❑ Reduce dependence on high energy intensity water supplies through conservation and use of local resources
- ❑ Leverage energy grants (SCE, SCG, DOE, CEC) to develop sustainable, renewable energy supplies

Chino Basin Concern: The Environmental Impact



RP-5 Site Layout

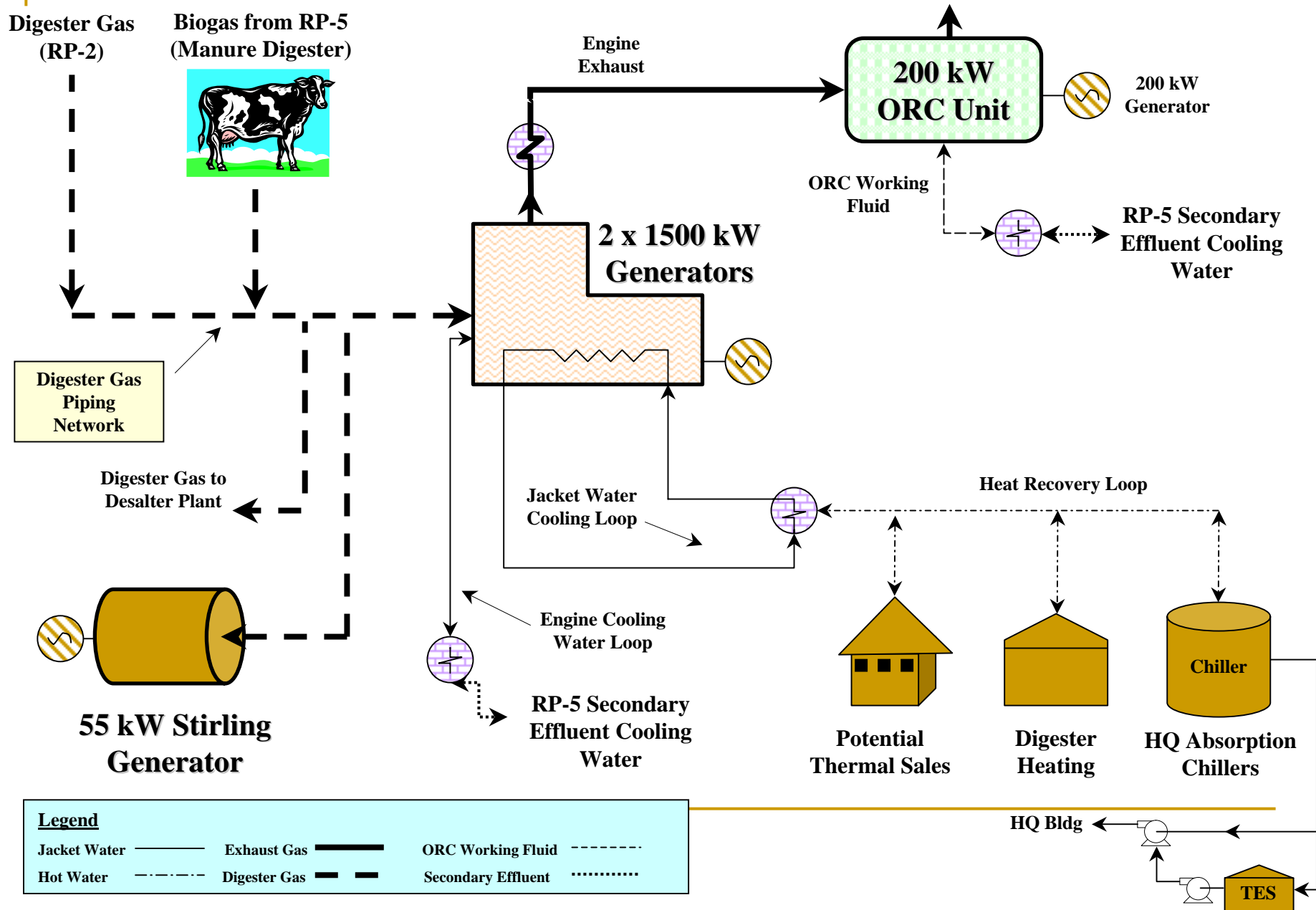


RP-5 Recycled Water Facility

Energy Highlights

- First and largest public LEED Platinum headquarters
- 60kW photovoltaics - 5 manufacturers and 12 models
- RP-5 Renewable Energy Efficiency Project (REEP) in partnership with DOE (65% efficiency goal)
 - ❑ State-of-the-art power generation facility (4.5 MW)
 - ❑ Secondary power generation (200 kW) via an Organic Rankine Cycle (ORC) using heat recovered from engines exhaust
 - ❑ Stirling engine generator system (55 kW) using digester gas
 - ❑ Thermal energy storage – generates and stores chilled water
 - ❑ Absorption chillers for the headquarters buildings use heat recovery from engine jackets and exhaust

RP-5 GENERATION AND HEAT RECOVERY



Centralize Digester Facilities RP-5 Renewable Energy Project

Manure Digester Phase Overview

- Phase IA – Plug Flow Digester 500 kW
(California Energy Commission,
U.S. Natural Resources Conservation
Service)
- Phase IB – Expansion & Modification 1,000 kW
(Western United Dairymen Grant)
- Phase II – European-design Digester 1,500 kW
First European design in Nation
(California Energy Commission, Milk
Producers Council)

Total Planned Digester Energy: 3,000 kW



RP-5 Renewable Energy Project

Phase IA

Original Digester

History

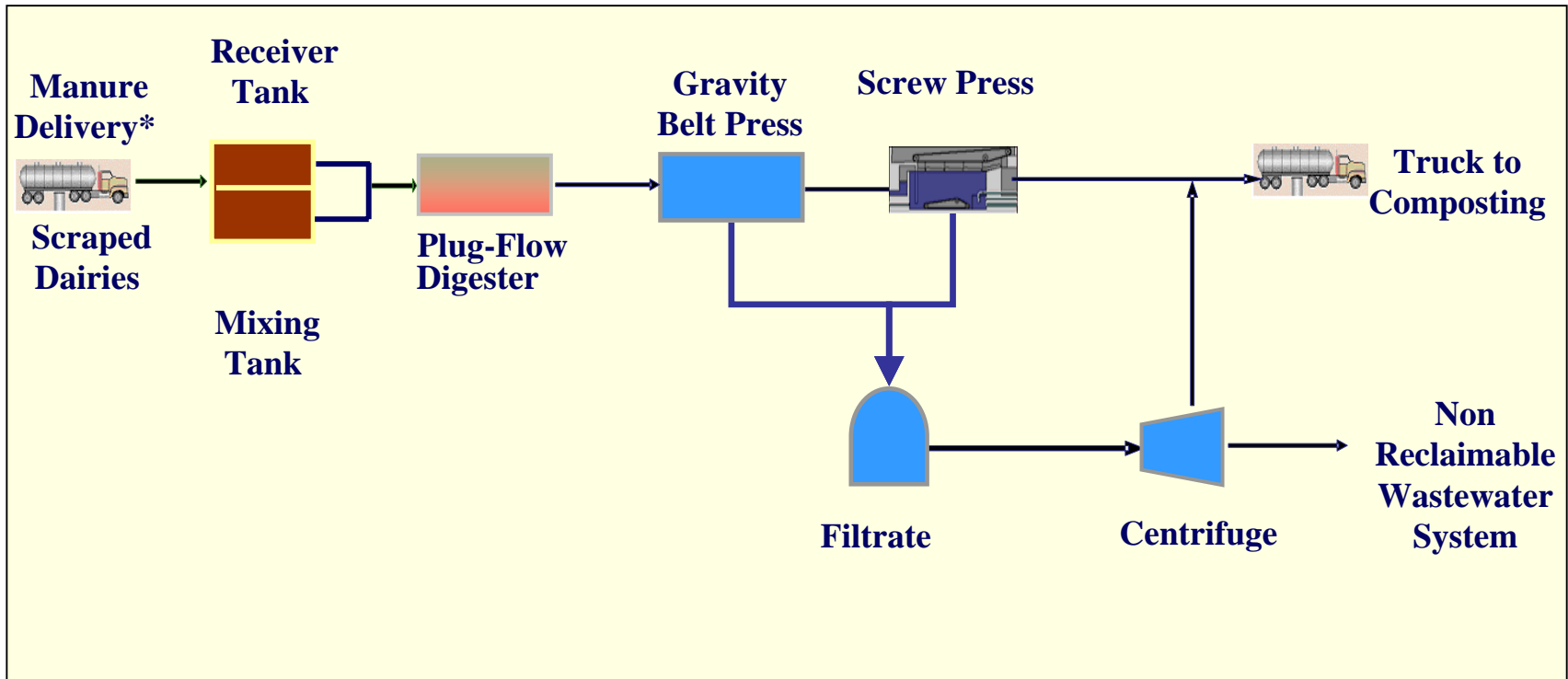
- Plug flow digester
- Scraped dairy collection method
- The facility has been operating for 30 months
- One of the largest commercial centralized system in the United States to convert dairy cow manure to power
- Originally a private-public partnership with IEUA, Milk Producers Council, and Synagro Technologies, Inc.



RP-5 Renewable Energy Project

Phase IA - Original Digester

Operations



Note: *Manure Delivered via a gravity feed

RP-5 Renewable Energy Project

Phase IA - Original Digester

Results

Capacity (12% Wet Tons/Day)	255
Temp. (°F)	95
Gas Production (ft ³ /day)	158,000
VSR %	26
HRT (Days)	21

Note: Data Reported is for 2002

What have we learned?

RP-5 Renewable Energy Project

Phase IA - Original Digester

Operational Summary

Description	RP-1 Manure Digester	RP-5 Manure Digester
Digestion Process	Complete mix thermophilic	Plug flow mesophilic
Average Hydraulic Retention Time (HRT)	15 days	21 days
Volatile Solids Reduction (%)	38%	26%

RP-5 Renewable Energy Project

Phase IA - Original Digester

Challenges

- Excessive staff time required for overall facility operation
- Problems with manure delivery:
 - Rocks
 - Debris
 - Ear tags
 - Grit
 - Odors
- The debris discharged into the receiving tanks causes pump clogging.



RP-5 Renewable Energy Project

Phase IA - Original Digester

Challenges (Cont'd)

- Top-draw pumps
 - ❑ High solids/grit influent
 - ❑ Low suction lift
 - ❑ Clogging problems

- Decreased Digester Capacity
 - ❑ Grit settling in front area of Digester

- Insufficient heat



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Phase IA - Original Digester

Challenges (Cont'd)

- Dewatering equipment
 - High energy consumption
 - Low solids capture
- High moisture and odors
- Significant housekeeping
- High maintenance costs



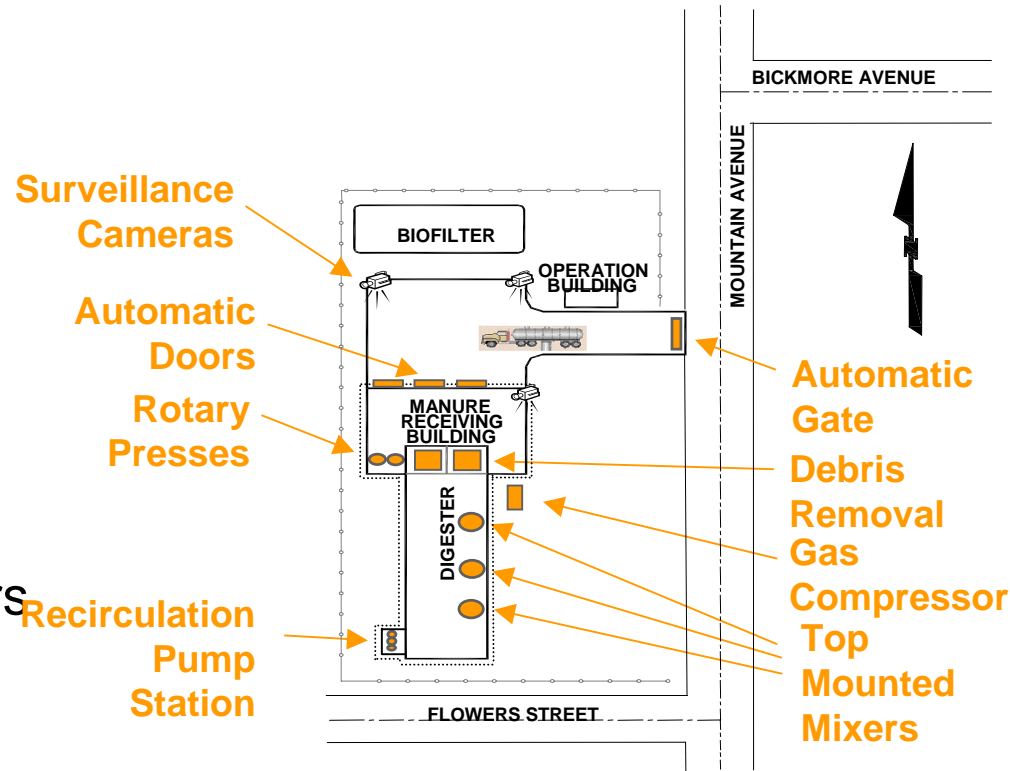
What we did ?

RP-5 Renewable Energy Project

Phase IB – Expansion & Modifications

1. General site facility automation for remote operation at Headquarters

- Installed a SCADA (supervisory control and data acquisition)
- Installed an automatic gate entrance
- Installed automatic building doors
- Installed remote access surveillance cameras



RP-5 Renewable Energy Project

Phase IB – Expansion & Modifications

2. **Added debris removal and odor control facilities at the manure receiving tank area**
 - Installed automated bar screens – to remove rocks, debris, ear tags etc.
 - Modified covers to remain closed while unloading trucks



RP-5 Renewable Energy Project

Phase IB – Expansion & Modifications

3. Converted the “Plug Flow” digester to a “Modified Mix” digested

- Installed a dry pit recirculation pump station
- Modified the digester heating & mixing piping
- Installed top mounted mixers
- Installed a gas compressor
- Operate in a thermophilic temperature range



RP-5 Renewable Energy Project

Phase IB – Expansion & Modifications

4. Expanded the dewatering facility:

- Increased treatment capacity
- Installed two rotary screen presses
- Reduced power consumption



5. Automated the digester control system

6. Adding of food waste to increase biogas production



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Phase IB – Expansion & Modifications

Results

- Reduced staff time
 - Enhanced heating
 - Enhanced mixing
 - Increased grit suspension
 - Increased reactor flow through rates
 - Added recycled flows
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Phase IB – Expansion & Modifications

Results (Cont'd)

- Increased gas production from 158,000 to 450,000 ft³/day
 - Increased manure loading capacity from 225 to 315 tons/day
 - Decreased detention time from 21 to 15 days
 - Increased percent total solids in cake from 22% to 40% TS
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What's next ?

Centralize Digester Facilities

RP-5 Renewable Energy Project

Phase II – Expansion

Background

- Partially funded by the California Energy Commission (CEC) with a \$3 million grant.
 - Utilizes a complete mix European technology (the first in the U.S.)
 - Demonstrates efficient anaerobic digestion for a centralized digestion system using innovative technologies.
 - Provides an efficient and reliable facility
 - Seeking additional funding
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RP-5 Renewable Energy Project

Phase II - Expansion

Proposed Digester Design Capacity

Dairy Manure Capacity	300 wet tons/day (12% total solids)
Food Waste Capacity	90 wet tons/day (20% total solids)
Volatile Suspended Solids Reduction	50%
Biogas Production	686,900 cu.ft./day
Power Generation (90% run-time on generation)	1,500 kW

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Phase II - Expansion

Proposed Design (conceptual)



Manure Biogas Plant in Germany

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Phase II - Expansion

Projected Phase II Schedule

Design Completed November 2005

Awarded Construction Contract March 2006

Construction Completion December 2006

RP-5 Renewable Energy Project

Phase II – Expansion

Expected Annual Expenses & Revenue

Capital Cost	\$ 4,970,000
Annual Revenue (savings)	\$ 1,333,652
Annual Expenses	\$ 569,525
Total Net Revenue (savings)	\$ 764,127

Environmental Benefits

- **Renewable Energy – Increase Self Sufficiency, Green Power**
 - ❑ Self Sufficiency/Reduced Peak Load
 - ❑ Support State's Goals for Renewable Energy Portfolio

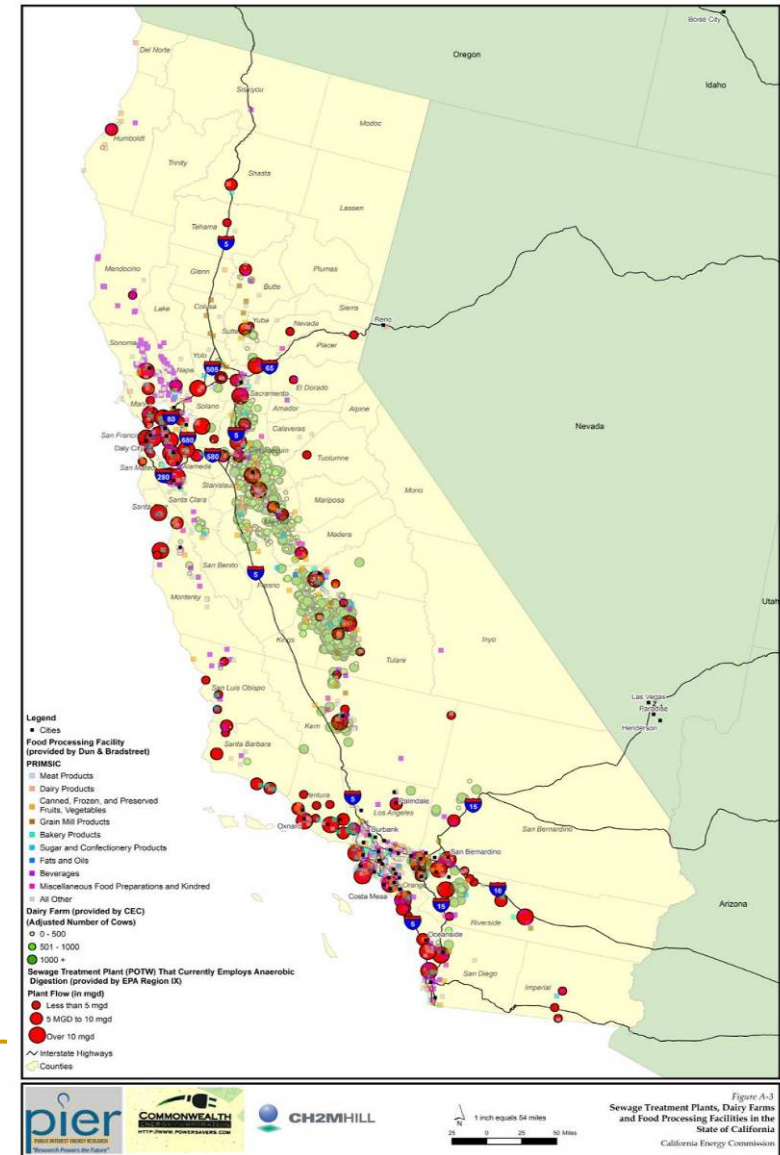
- **Water Quality – Reduce Salt and Nitrates**
 - ❑ Achieve Goals of Santa Ana Region Water Basin Plan/OBMP/CAFO rules
 - ❑ Support Recycled Water/Conjunctive Water Management Programs and regional goal of reducing demand for imported water supplies
 - ❑ Protect Downstream Water Users

Environmental Benefits

- **Air Quality – Reduce Pollutants, Greenhouse Gases, NH₃**
 - Achieve Goals of South Coast Air Quality Management District including New Composting and CAFO Regulations
 - Reduce Global Warming Gases (Federal Clean Skies)
 - Reduce Diesel Truck Traffic
 - **On Farm and Quality of Life Improvements**
 - Less odors and flies
 - Improved herd health
 - **Regional Soil Quality Benefits**
 - High quality compost improves low organic soils
 - Secondary benefits (NRCS Soil Quality Inst. Web site)
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Opportunities for Centralized Digestion

In California, as elsewhere in the nation, there are many opportunities for the use of centralized digesters that process a combination of dairy manure, biosolids, and dairy waste



COMMENTS
